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ENERGY EDUCATION

Minigrant

PROJECTS

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ENERGY EDUCATION MINIGRANT PROJECTS

A DIRECTORY OF
1987-1988 PROJECT REPORTS

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DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
LEE METCALF BUILDING
1520 EAST SIXTH AVENUE
HELENA, MONTANA 59620-2301
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SEPTEMBER 1988

CONTENTS

Introduction 1

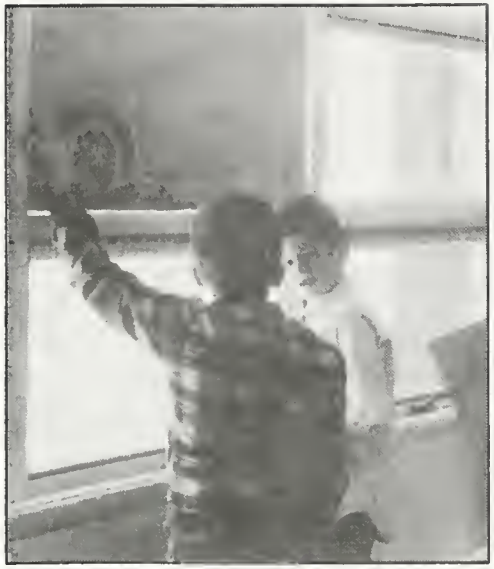
Project Descriptions 4

- Project Solar 4
- Making Windows a Wall 5
- Solar Panel 6
- Effects of Solar Heating on Seeley-Swan High School 8
- Wind Tunnel 9
- Wind Energy Development in Browning, Montana 11
- Energy Education Trunk 12
- Energy, the Force That's With Us 13
- Power Generation via Renewable Energies 14

INTRODUCTION

The Montana Department of Natural Resources and Conservation (DNRC) is offering a collection of reports from the Energy Education Minigrant Program for free use by Montana teachers. Through the Minigrant Program, DNRC seeks to foster the development of creative classroom energy projects and distribute information about these projects so teachers in other Montana schools can undertake similar activities.

Nine minigrants, up to a maximum of $500 each, were awarded to Montana teachers during the 1987-88 school term. Projects ranged from assembling a library of energy-related books and audio-visual materials, to generating electricity with windmills designed and constructed by students. This directory contains summaries of the reports prepared by teachers who conducted the minigrant projects. Each summary describes project locations, teachers serving as directors, grade levels and number of students involved, educational goals, and activities conducted. Also, information on how to order the reports is given below.



Conferring on quality control at Marion.

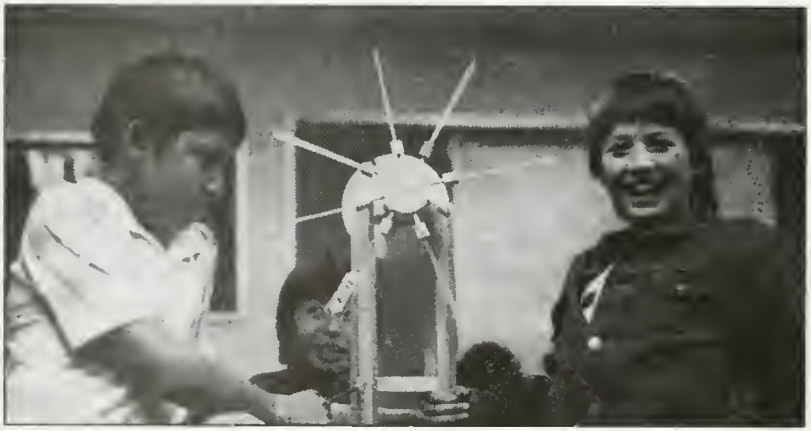
DNRC has prepared the directory to publicize the nine minigrant projects completed during the program's first year and to promote information exchange among Montana teachers. We encourage teachers to use the directory in developing their own projects. We have included the names and addresses of the teachers who have designed and implemented the projects. You may wish to contact them to benefit from the lessons learned through their experiences.

How to Order

The reports described in this directory are available to any individual or group from Montana or another state. All requests must be directed to DNRC's Energy Division. When placing an order for a report, please let us know that it is a minigrant project report and identify:

- Report ID Number
- Project Title
- Name of School
- Town
- Project Director

If you wish to receive a copy of a report, or for more information on how to apply for a minigrant, contact: DNRC; Energy Division; 1520 East Sixth Avenue; Helena, Montana 59620-2301; (406) 444-6697.



Harnessing energy at Browning.

Project Solar

Bloomfield School
PO Box 24
Bloomfield, Montana 59315
583-7575

REPORT ID NUMBER: EDG-88-7520

PROJECT DIRECTOR: Linda Borntrager

GRADE LEVEL: K-8

NUMBER OF STUDENTS REACHED: 26

SUBJECT: Science, Language Arts, Math

PROJECT COST: $501

Bloomfield teacher Linda Borntrager was familiar with the use of solar energy—she had helped plan and build a passive solar greenhouse, and her husband had installed a photovoltaic system to run their water pump and electric fenceline. Ms. Borntrager wanted to share her experience and "demystify" solar energy for her students by demonstrating the sun's power in the classroom.

Her students took field trips to see the solar greenhouse and the Borntragers' water pump and fence-charging system. After watching films on solar house design, the students planned and built a model passive solar house out of matte paper. A radiometer, photo cells, solar battery chargers, and kits to make solar-powered toys gave the students a range of fun ways to experiment with solar energy. The project that generated the most enthusiasm was a fresnel lens. Two 8th graders welded a free-standing frame for the high-powered lens so that it could be used as an outdoor oven. The entire school then cooked marshmallows and hot dogs by the heat of the sun. Such hands-on applications of solar energy brought tangible results that were readily enjoyed by the kids, making the project a great success. ❑

Making Windows a Wall

Home economics teacher Susan Wallace wanted to cut heat losses from her north-facing classroom. By having her 6th grade class design and build insulating window covers, she gave her students a firsthand lesson in energy conservation and, at the same time, improved the heating efficiency of Marion School.

Students participated in planning, drafting, and constructing the window covers. Students first calculated the ratio of window area to floor area, checked for air exchange around windows and doors, recorded the amount of time required to heat the room, and compared the thermostat setting, room temperature, and windowpane temperature. The Thermax covers were designed to insulate each windowpane, and a student assembly line cut, glued, and stapled the covers together. After the covers were installed, students measured heating times, compared temperatures again, and found that the project did reduce radiant heat loss. Students will continue to collect data through the 1988-89 school year. ❑

Marion School
205 Gopher Lane
Marion, Montana 59925
854-2333

REPORT ID NUMBER: EDG-88-7523

PROJECT DIRECTOR: Susan Wallace

GRADE LEVEL: 6

NUMBER OF STUDENTS REACHED: 11

SUBJECT: Home Economics

PROJECT COST: $236

Solar Panel

Roundup High School
PO Box 717
Roundup, Montana 59072
323-2402

REPORT ID NUMBER: EDG-88-7518

PROJECT DIRECTOR: Margaret Lind

GRADE LEVEL: 9-12

NUMBER OF STUDENTS REACHED: 64

SUBJECT: Physics

PROJECT COST: $520

Solar energy has long been a favorite classroom topic for Roundup teacher Margaret Lind. But Ms. Lind wanted her solar energy lessons to be more engaging and memorable to her students; she wanted to give them firsthand experience with the practical applications of solar energy.

Students were introduced to solar energy in class workshops on color's effect on heat absorption, passive and active solar heating, and the direct conversion of solar energy to electricity. A laser and several lab kits with solar cells were ordered, and the laser proved to be an excellent tool for examining light and its properties. Students researched and wrote papers on the theory and safe use of lasers, then designed their own experiments. One of the most popular was a demonstration of light reflection, using 10 mirrors placed in an oval to bounce a light beam from mirror to mirror.

When the solar lab kits arrived, two students with previous electronics experience helped the class build circuits with solar cells and panels to run an air pump, spotlight, car stereo, and siren.

But the demonstration of solar energy that generated the most enthusiasm was a solar-powered radio station. Students wired a solar panel to a simple circuit that transmitted radio waves, and a radio in the classroom received the signals. The "class DJ" was able to broadcast several songs.

Ms. Lind plans to expand the light and solar energy unit for the 1988-89 school year. With more solar cells and lab kits, students will be able to build their own solar panels and circuits. Staying with the theme of practical applications, the main project during the winter will be a solar circuit to protect a charged car battery. Because students are so eager to work with solar power, Ms. Lind intends to set up a corner in the science lab for independent study. ❑

Experimenting with a flat plate collector at Will James.

Effects of Solar Heating on Seeley-Swan High School

Seeley-Swan High School
PO Box 416
Seeley Lake, Montana 59601
677-2224

REPORT ID NUMBER: EDG-88-7521

PROJECT DIRECTOR: Arthur Sikkink

GRADE LEVEL: 9-12

NUMBER OF STUDENTS REACHED: 30

SUBJECT: Physics, Computer Science

PROJECT COST: $302

Thirty students at Seeley-Swan High School investigated the potential for solar heat gain at their school and learned how to conduct a research project as they explored solar energy. Science teacher Arthur Sikkink put the entire project into student hands, from building the light and heat sensors and writing computer programs, to analyzing and reporting the results.

A computer science class wrote programs for collecting and collating data, while members of a physics class built electronic sensors to measure heat and light intensity. The sensors were calibrated in degrees celsius and foot candles and tested for accuracy. The "probes" were then placed in three test rooms and linked to the computer.The computer monitored heat and light intensity and collated average hourly temperatures and foot candles into 24-hour days. Data printouts compared changes from one week to the next and differences from room to room. Students were initially confused because there was no discernible pattern of heat gain in the rooms. With guidance, they learned to interpret the data and formulate their own theories, rather than looking for a ready answer. By the end of the project, students were more aware of the complexities of harnessing solar energy, and they had gained an appreciation for the challenges of the scientific research process. ❑

Wind Tunnel

The wind that usually blows through Cut Bank had piqued the interest of at least one technology education student. He set out to build a wind tunnel to study aerodynamics, and industrial arts teacher Mark Beckwith saw an opportunity to teach the basic concepts of wind energy: lift, drag, turbulence, and turbine efficiency.

The wind tunnel was constructed out of 6-inch diameter plastic pipe 60 inches long. A window was cut into the pipe and fitted with clear plastic to allow observation of test objects placed inside. Then a leaf blower was connected to the intake end of the tunnel, and a cup anemometer was installed at the tunnel exit to measure wind speed. Mr. Beckwith tried different methods of making "visible air" in the tunnel. The fire needed to generate enough smoke proved to be too risky, and dry ice (for vapor) was expensive. A local veterinarian donated some liquid nitrogen, which vaporizes at room temperature, and this worked well.

Mr. Beckwith drew up worksheets to guide students through experiments. Each worksheet relies on student observations of a test

Cut Bank High School
101 Third Avenue Southeast
Cut Bank, Montana 59427
873-5629

REPORT ID NUMBER: EDG-88-7516

PROJECT DIRECTOR: Mark Beckwith

GRADE LEVEL: 8-12

NUMBER OF STUDENTS
REACHED: More than 50 students a year

SUBJECT: Industrial Arts

PROJECT COST: $365

Studying energy topics in the Devlin library.

object under varying wind conditions in the tunnel. For the experiment on lift, the student connects the object to a balance scale through the wall of the tunnel. When the wind source is turned on, any lift created by the object registers as weight in ounces on the scale.

Once lift, drag, and turbulence have been studied, students can apply these concepts to the design and construction of a model wind turbine. The wind tunnel is used again to test the turbine to see if it measures up to design expectations. Students can compare the efficiency of different types of turbines and refine their own understanding of aerodynamics.

Over 30 8th graders and 8 high school technology education students are expected to use the Cut Bank wind tunnel during the 1988-89 school year. High school science classes will also have access to the tunnel. ❑

Wind Energy Development in Browning, Montana

The eastern front of the Rocky Mountains can be windy, and Browning is known to have its share of breezy days. Middle School teacher Meg Langley used this condition to her advantage when she asked her students to study the wind power potential just outside the classroom.

Using anemometers and wind dials, students measured wind speed and direction every day for several weeks. They graphed their results to get a sense of how consistently the wind blows, an important factor in wind power generation. This field work was complemented by a classroom review of the history and design of windmills. With a new appreciation for the usefulness of the wind, 14 students spent additional time in woodshop class designing and building their own working, small-scale windmills from scratch. The woodshop teacher, Mr. McKenty, helped interpret the blueprints and gave a hand to the less experienced woodworkers. The wind graphs and model windmills were then proudly displayed at the school's annual science fair, attracting schoolwide interest and further spreading the lesson of the wind's usefulness. ❑

Browning Middle School
PO Box 610
Browning, Montana 59417
338-2725

REPORT ID NUMBER: EDG-88-7519

PROJECT DIRECTOR: Meg Langley

GRADE LEVEL: 6-8

NUMBER OF STUDENTS REACHED: 14

SUBJECT: Science

PROJECT COST: $295

Energy Education Trunk

Warren Elementary School
2690 York Road
Helena, Montana 59601
442-6002

REPORT ID NUMBER: EDG-88-7522

PROJECT DIRECTORS: Barbara Ridgway
Gene Menicucci

GRADE LEVEL: K-6

NUMBER OF STUDENTS REACHED: Up to 4,000

SUBJECT: Science

PROJECT COST: $515

Librarian Barbara Ridgway and teacher Gene Menicucci teamed up to assemble a traveling energy trunk for Helena School District No. 1. The trunk is an instructional unit in a box that will circulate to 13 schools in the district, ultimately reaching 4,000 elementary students.

Ms. Ridgway and Mr. Menicucci spent many hours poring over vendors' catalogs, ordering materials "on approval," and selecting the items that best served the needs of the district. The result is an incredibly diverse treasure chest of energy-related reading materials, audio-visual aids, and hands-on activities. The trunk includes up-to-date books, posters, maps, filmstrips, cassettes, computer software, several radiometers, and even a sample bag of coal. There are also kits for an atomic energy lab, solar-powered fans and ovens, and a working steam-powered engine.

Both students and teachers are enthusiastic about the energy trunk. The materials are a welcome addition to the district's regular science program. ❑

Energy, the Force That's With Us

Teachers at the Devlin School wanted to heighten student awareness of Montana's energy resources—how fossil fuels are used, how energy can be conserved, and what renewable sources are available. To meet this objective, the school purchased books, posters, cassette tapes, and filmstrips on energy. To demonstrate solar energy in the classroom, an inexpensive radiometer for observing the effect of radiant energy from the sun was also purchased.

Librarian Susan Martenson and teacher Judy Graham presented the materials to the rest of the Devlin faculty at an in-service orientation. The response was enthusiastic and one 3rd gradeteacher immediately signed out all of the filmstrips and kits to teach an intensive energy unit during the spring of 1988. Roughly a third of the targeted student body was able to use the materials before the end of the 1987-88 school year. All of the materials are housed in the school library and are available for use in the classroom.

The program was off to a good start last year. Teacher and student use will be monitored during the 1988-89 term to further determine the popularity and effectiveness of the materials. ❑

Devlin Elementary School
500 First Avenue
Havre, Montana 59501
265-5841

REPORT ID NUMBER: EDG-88-7515

PROJECT DIRECTORS: Susan Martenson
Judy Graham

GRADE LEVEL: K-3

NUMBER OF STUDENTS
REACHED: More than 60 students a year

SUBJECT: Science

PROJECT COST: $311

Power Generation via Renewable Energies

Will James Junior High School
1200 Thirtieth West
Billings, Montana 59102
255-3750

REPORT ID NUMBER: EDG-88-7517

PROJECT DIRECTOR: Curt Prchal

GRADE LEVEL: 7-8

NUMBER OF STUDENTS
REACHED: More than 100 students a year

SUBJECT: Industrial Arts

PROJECT COST: $450

Industrial arts teachers are going beyond basic woodworking and welding to introduce their students to the high-tech world of the 1990s through technology education programs. Billings School District No. 2 recently expanded its technology education curriculum to include the study of renewable energy sources. Industrial arts teacher Curt Prchal took the opportunity offered by DNRC's minigrant program to develop four learning units on renewable energy. All four units—solar, wind, biomass, and water—focus on energy sources found in Montana.

Solar and wind, the first two units developed by Mr. Prchal, were inaugurated in the spring of 1988. Students began the solar unit by listening to introductory lectures and then completing a chronological chart of events in the history of solar energy. A firsthand understanding of solar power was gained by using lenses and reflectors to amplify the sun's rays, and the students learned to wire solar cells and assemble them into collector panels. They also investigated storage systems, learning how a battery works and how to charge one with solar power.

This new understanding of solar technology was combined with traditional shop skills to explore a number of practical applications. Students built solar-powered air and water heaters, a fruit dryer, a greenhouse, and a sun oven. Design and construction were treated as a discovery process, allowing time for independent study and brainstorming. Rather than following the traditional "cookbook" method for shop projects, students were encouraged to look for innovative solutions as problems arose. Enthusiasm ran high, and students were eager to spend time perfecting their projects.

The wind power unit was structured along the same lines, focusing on the mechanical and electrical applications of wind energy. Students learned how to build anemometers and use them to measure wind speed and power. Then they studied windmill design and built their own propellers, drive trains, and towers. Both units ended with class presentations and worksheets fostering student awareness of career opportunities in solar and wind power. The learning units, including the units on biomass and water energy, are being distributed throughout the school district. Mr. Prchal expects to teach all four units during the 1988-89 term, reaching over 140 students in the technology education curriculum. ❑

Testing a two-blade propeller at Will James.

Montana Department of Natural
Resources and Conservation
Energy Division
1520 East Sixth Avenue
Helena, MT 59620-2301